

DIPTERANS BIODIVERSITY OF AGRICULTURAL AND MEDICO VETERINARY INTEREST IN THE MARSH OF REGHAIA (ALGERIA)

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ABSTRACT

The present study is performed in three stations of Marsh of Reghaia from October 2009 to June 2010. The aim of this work is to study richness of Dipterans by use of coloured traps methods. According to this study, we underline 54 species in surroundings of the Marsh, 41 ones in station of the maquis and 29 others in station around ponds. In terms of species, *Chironomus plumosus* is the most prevailing in surroundings of the Marsh (AR% = 32.04%), *Leptocera septentrionalis* dominates in maquis (AR% = 42.36%) and *Elachiptera corunata* (RA% = 42.54%) is the most prevailing around ponds.

KEYWORDS: Dipterans, Biodiversity, Coloured Traps, Marsh of Reghaia Algeria

INTRODUCTION

Medical and veterinary entomology considers that Dipterans, notably hematophagous are the main vectors of infectious diseases, quoting malaria which is transmitted to human by tens of Culicidae species, Sand flies as for them are dipterans vectors of Leishmaniosis particularly in North African seats. Somewhere else, in agricultural field, too much of Nematocera species can attack cultivated vegetables and provoke yield decrease during crops harvesting in notable proportions. It is the case of much species of cecidomyiidae which provokes galls formation and foliar deformations. Larvae of Tipulidae, other neighbour family gnaw roots of various graminaceous and devour seeds and grains in germination nearing. They can be harmful to cereals as maize, cabbage and various others cultures (Matile, 1993). In spite of the bad and dangerous nature of some species, most of them play a very important ecologic role not only by participating to eliminate excrement (coprophagous species) but also carcass bodies (necrophagous species). Aquatic larvae of some species such as Chironomids represent more than 10% of fish and batrachians die of lakes and marshlands (Fontaine and al, 1976). On this multitude of ecologic variance, we cannot ignore importance of that insects order. In Algeria, the whole works on dipterans were aimed towards systematic and bio-ecology of Nematocera particularly of Culicidae and Psychodidae. That's the case of Berchi's (2000) works and of Berchi and al (2012) in region of Constantine, of Hassaine and al (2001) in region of Ttemcen, of Bouabida and al (2012) in region of Tébessa; of Boudemagh et al (2013) in region of Collo of Boulkenafet and al (2007) in region of Skikda and of Boukraa and al (2011) in region of M'Zab- Ghardaia. On the other hand, works undertaken in region of Algiers were limited and often not published (Lounaci, 2003; Lounaci and al, 2011,2013); The present work deals with biodiversity of Brachycera and Nematocera Dipterans of Marsh of Reghaia by development of a new list of species of agricultural and medico-veterinary interests.

PRESENTATION OF MARSH OF REGHAIA

Marsh of Reghaia ((36°46'N; 3°20'E), situated at 30 km to East of Algiers is a damp coastal zone linked up to estuary of Reghaia's Oued which empties into Mediterranean sea. It is considered as protected site and of international importance. The whole site presents a water capacity of four million cubic meters which gives a surface between 100 to 150 hectares (Ledant and al, 1979). This region belongs to bioclimatic stage sub-wet with temperate winter according to data of 2000 and 2010. Precipitations are yearly from 735 to 758 mm. Generally they split up from October to April with peaks in December, January and February. This site gathers actually favourable conditions for installation and multiplication of insects as well land as aquatic ones for season nesting and wintering migratory birds and to upholding of wild mammals. Considering the noticeable diversity at level of meshes, three samplings stations were so chosen (Figure 1). The first station (S1; 36°46'2"N, 3°20'22"E) is situated at marsh border facing cynegetic centre buildings. The second station (S2; 36°46'2"N, 3°20'24"E) is in maquis at one kilometre higher than the first one where is remaining an afforestation of Eucalyptus, of small reed-beds and bulrushes areas. The third one (S3; 36°46'45"N, 3°20'9"E) is represented by a meadow which corresponds to pasture land in place in South-West of the Reghaia's Marsh which presents some ponds flowed by water tables and by rain waters, around them are set traps to harvest Dipterans. Choice of the sites is based on involvement of Dipterans in the environment, accessibility and non treatment.

MATERIALS AND METHODS

The objective of coloured traps use is to capture heliophilous and floriculture insects (Roth. 1972). These traps present double attractive power because on the one hand to their shade lemon yellow which exerts more higher influence than others colours (Villiers 1977) and on the other hand to presence of water, vital element for insects (Lamotte and Bourliere, 1969).). In the present study, 10 yellow traps of 35 cm diameter and of 15 cm height are put in each station on the ground at 5 meters interval. They are set in place between October 2009 and June 2010 between 13 and 17 of each month. Each one of those traps is full of water at $\frac{3}{4}$ of its height, added with pinch of detergent preventing trapped insects to escape. Then 24 hours later, samples are carried to laboratory. Identification of captured species is made on the base of guides and dichotomous keys particularly those of Seguy (1923, 1926, 1927, 1934.1940) of Pierre (1924), of Goetghebuer (1932), of Leclercq (1971), of Mc Alpine and al (1987), of Perrier (1983), of Matile (1993, 1995) and of Brunhes and al (1999). This identification is performed by Professor Doumandji Salaheddine.

Results exploitation is made on the one hand by composition ecological indexes which are: total richness (S) and relative abundance RA% and other part by ecological indexes of structure which are diversity index of Shannon Weaver (H) obtained by formula: $H' = - \sum q_i \log_2 q_i$ where H' is index of diversity expressed in bits and q_i relative frequency of specie i taken in consideration (Lamotte and Bourliere, 1969) and equitability index (E) which is link of observed diversity (H') to maximal diversity. (H' max). Maximal diversity is given by formula $H' \text{ max} = \log_2 S$ where S is total richness (Ramade, 2009). Equitability varies between 0 and 1.

Furthermore, as statistical method, factorial analysis of correspondences is used. It allows specifying sharing out norms of ecological universe where numerous species have to intervene It widely justify simultaneous species representation (Blondel, 1979).

Factorial analysis of correspondences aims to gather in one or several graphics the largest part of information contained in tableau (Delagarde, 1983).

RESULTS AND DISCUSSIONS

Results on Ecological Indexes of Composition

The individuals' number captured in coloured traps varies according to stations and to months. Yes, in borders (edges) of Marsh 20.944 individuals spread between 54 species are captured. The sub-order of Brachycera is better represented with 72.73% among *Gymnophora* sp. noted in October (AR= 26.24 %) and November (AR= 23.84%) of year 2009 and *Platypalpus trivialis* (AR= 18.16%) noted in June of year 2010. The sub-order of Nematocera is in second position with 27.27% among *Chironomus plumosus* captured in October (38.49%) and November (54%) of year 2009. This last one predominates (41.31%) in June followed by undetermined specie of Cecidomyiidae (38.28%) in May and *Sciara bicolor* (44.44 %) in April of year 2010 (Table 1). In the sheepfold of El Harrach, Berrouane and Doumandji (2012) shows presence of 93 Dipterans' zoophiles species sampled thanks to the same types of traps. Those last ones are spread between 35 of species 'families. During systematic inventory of Culicidae in region of Milia, Messai and al (2011) had harvested 1567 individuals at level of different prospected lodgings. Those same authors had noticed that specie *Culex pipiens* keeps the first position with 958 larvae, which is 61.1% of the whole. Second position occupied by *Culiseta longiareolata* with 236 larvae, which is 15.1%. In third position *Anopheles labranchiae* comes with 145 larvae which is 9.3%. Likewise for Boudemagh et al (2013) who note the higher frequency of *Culex pipiens* with 52.4% in region of Collo in urban and rural environments.

In maquis station, 1093 individuals spread between 35 species are harvested. During year 2009 there are others species which are dominating (Table 2) among them *Leptocera septentrionalis* (55.43 %) and *Elachiptera corunata* (18.99 %) belonging to sub-order of Brachycera representing the higher rate with 73.53 %. In the same station, in May of year 2010 *Leptocera septentrionalis* (RA% = 34.72%) dominates followed by *Sepsis* sp. (26.42 %) and *Leptocera atoma* (20.21 %). In June they are the same species which predominate with respectfully 59.02%, 12.84% and 10.11%. Berrouane and al (2010) by searching Diterans of medico-veterinary interest underline in Marsh of Reghaia, in July and September 2009, proliferation of an undetermined specie of Chironomidae with 42.8% by using the same trapping technique. On year later, these same authors note in borders of the Marsh of Reghaia, dominance of Cyclorrhapha undetermined specie in yellow plates with rate of 81.8 %. In the same region, Lounaci and Doumandji (2012) have identified 7 Dipterans families Nematocera, these of Cecidomyiidae, of Sciaridae, of Culicidae, of Chironomidae, of Psychodidae and of Tipulidae. Furthermore, 8 families of Brachycera are noted corresponding to Stratiomyidae, to Asilidae, to Conopidae, to pipunculidae, to Syrphidae, to Calliphoridae, to Agromyzidae and to Sepsidae. In semi arid bioclimatic stage of the region of Constantine Berchi and al (2012) from October 1995 to September 1997 count a total of 24.190 mosquitoes belonging to four genders among them 24.139 *Culex*, 47 *Culiseta*, 3 *Anopheles* and 1 *Uranotaenia*. *Culex pipiens* corresponding to 97.5 % of the total trapped fauna.

In station of ponds, 369 individuals spread between 29 species are inventoried. It is underlined dominance of three Dipterans species, which are *Elachiptera corunata* of family of Chloropidae captured in October (AR% = 56.52 %) and in November (AR% = 54.45 %) of year 2009 corresponding nearly to half of captured individuals (Table 3). *Culicoides imicola* (20.29%) of family of Ceratopogonidae and *Psycoda alternata* (23.76%) of family of Psycodidae noted respectively in October and November.

Maximum of trapped species is recorded in Spring of year 2010 in borders of the marsh and in maquis in Autumn 2009 around of ponds, which are respectively 25 species in May and 16 in June and 14 in October displaying a total

richness equal to 92 species during the nine months of sampling. In saharian bioclimatic stage of Ghardaia region, Baba Aissa (2012) during dipterans' study had underlined a maximum of species in October which is of 43 species at Belghennem-Ogba, 32 species at Tadjninte and 20 species at Zefaba. Near of sheepfold at El Harrach, Berrouane and Doumandji (2012) had shown presence of 2746 dipterans' individuals, spread between 35 families captured in coloured traps with the most represented is *Leptocera curvineris* with 786 individuals and by *Elachiptera corunata* with 264 individuals.

Results of Ecological Indexes of Structure

Values of monthly diversity of Shannon-Weaver (H) vary between 1.52 bits and 3.02 bits in borders of Marsh, between 2.01 and 3.58 bits in Maquis and between 1.27 and 3.37 bits at the surroundings of Ponds. These values translate higher diversity of species in the three study stations. These present results confirm those ones of Berrouane and Doumandji (2012) which shows values being between 3.24 bits in Sheepfold of El Harrach and 4.43 in Jardin d'Essai EL Hamma Algiers. Values of equitability obtained according to trapped species in the three stations fluctuate from month to another (table 4). All of them are superior to 0.52 and tend towards 1, which implies that species effectives in presence have tendency to be in balance between them. During his study on biodiversity of sand flies in region of Skikda, Boulkenaf (2006) has obtained value of diversity of Shannon-Weaver in the five stations equal to 1.31 bits, a maximal diversity H'_{max} of 9.59 and an equal equitability to 0.14. This populating is not much diversified and effectives of species which compose it are unbalanced between them. In the same region, author noted that Culicidae populations are not much diversified in spite of $H'=3.04$ bits ($H'_{max} = 4.9$ bits) and that present species effectives have tendency to be in balance between them ($E=0.6$). In the other hand in region of Collo Boudemagh and al (2013) noticed that in 8 stations of urban environments, values of Shannon-Weaver diversity vary between 1.0 bits in station 8 and 2.9 bits in station 2. Likewise, values of equitability fluctuate between 0.6 in station 6 and 1 in station 2.

Results Exploiting by Factorial Analysis of Correspondences

Factorial analysis of correspondences made, has as aim to put in evidence the common species between the three study stations: the ones of surroundings of Marsh, of Maquis and those of Ponds and to bring out those which are characteristic to each of the three stations (Figure 2). Contribution to total inertia of captured Dipterans species is equal to 25.6% for axis 1 and of 22.7% for axis 2. Axes 1 and 2 represent respective inertias of 42% and 26% of total variation. Axis 3 presents a weak rate (17%) of inertia and did not have been retained for interpreting. Stations of around of Marsh (AMR), of Maquis (MAQ) and Ponds (PON) are situated in three different quadrants. The maquis (MAQ) is in first quadrant, around of marsh (AMR) in quadrant 2 and ponds (PON) in third quadrant. We deduce that the three stations are different between them by species contents. Baba Aissa (2012) used a factorial analysis of correspondences according to Nematocera dipterans species captured in region of M'Zab thanks to coloured traps. This author has highlighted scattering of the stations which are Tadjninte, Laadira and Zelfana in three different quadrants. As for distribution of species according to quadrants, it is noted formation of 4 groups where the first is referred by A contains omnipresent species which are common in three study stations. These are *Psychoda alternata* (002), *Chironomus plumosus* (009) and *Sepsis punctum* (054) (Annex 1). On the contrary, results of factorial analysis of species Dipterans correspondences performed by Tamaloust (2007) highlighted that only one specie *Culex pipiens* is omnipresent between the three stations, the ones of Marsh of Reghaia, of Agronomic National Institute of El Harrach and of Palm grove of Filiach (Biskra). Group B gathers species only species found in station around marsh (AMR) as *Pencoma fusca* (001) and *Pyrhrocoris* sp. (001) and *Culex*

pipiens (004) with their harmfulness caused by this one is strongly felt in the region. Group C gathers trapped species only at level of maquis (MAQ), particularly *Pachyrhyna* sp. (031), *Chorisops* sp (032), *Cephalochrysanigricornis* (033), *Leptocera atoma* (043), *Leptocera septentrionalis* (044). Finally, Group D is composed by species trapped only at level of ponds stations (PON) as *Anopheles labranchae* (004). *Culicoides albicans* (018). *Sericomyia silensis* (053). *Caliphora vicina* (066). These results contradict those ones found by Boukraa (2009) which shows that *Culicoides albicans* is omnipresent in the three stations, those of Lardaa, of Tadjanant and of Zelfana (Ghardaia). Baldet and al (2005) and Zimmer and al (2008) maintain that blue tongue virus is transmitted by bites of female midges of some species as gender of *Culicoides* among them *Culicoides albicans* and *Culicoides imicola*,

CONCLUSIONS

A great number of captured species in coloured traps show the big diversity of Dipterans in Marsh of Reghaia. *Chironomidae* seem to be very frequent as *Chironomus plumosus* and so Ceratopogonidae with *C. imicola*, *C. albicans*, *C. absoletus*, *C. Copiosus*. Culicidae are represented by *Anopheles labranchiae*, *Culex pipiens*, *Cx. impudicus* and *Culiseta* *Culicoides copiosus longiareolata* Phoridae with *Gymnophora* sp. Syrphidae with *Eristalis tenax* and Chloropidae Elachiptera corunata. Particular attention must taken for Ceratopogonidae, especially *Culicoides. imicola*, *C. albicans*, *C. absoletus* and *C. copiosus* where presence proves to be a risk for health of bovines, ovine and goats.

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APPENDICES

Table 1: Relative Abundance of Dipterans Species Captured in Coloured Traps in Station Surrounding Marsh of Reghaia

		2009										2010									
		X	XI		XII		I	II		III		IV	V		VI						
		ni	AR %	ni	AR %	ni	AR %	ni	AR %	ni	AR %	ni	AR %	ni	AR %	ni	AR %				
Familles	Espèces																				
	Sous-ordre des Nematocera																				
	<i>Pericoma fusca</i>	-	-	-	-	-	-	-	-	-	-	2	2,47	-	-	-	-	-	-		
Psychodidae	<i>Psychoda alternata</i>	6	1,29	2	1,16	-	-	-	-	-	2	15,4	1	1,23	9	2,09	68	7,53			
	<i>Phlebotomus perniciosus</i>	-	-	-	-	-	-	-	-	-	-	1	1,23	-	-	-	-	-	-		
Culicidae	<i>Culex pipiens</i>	1	0,22	1	0,58	1	6,25	-	-	-	-	-	-	2	0,46	-	-	-	-		
	<i>Culiseta longiareolata</i>	-	-	-	0,00	-	-	-	-	-	-	-	-	2	0,46	-	-	-	-		
Chironomidae	<i>Chironomus plumosus</i>	179	38,49	93	54,07	-	-	-	-	-	-	13	16,05	13	3,02	373	41,30				
	<i>Chironomus tendens</i>	-	-	2	1,16	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	<i>Chironomus nubeculosus</i>	1	0,22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Tipulidae	<i>Tipula sp.</i>	-	-	-	-	-	-	-	-	-	-	-	1	1,235	-	-	-	-	-		
Sciandae	<i>Sciara bicolor</i>	1	0,22	2	1,16	1	6,25	2	40,00	4	50	-	36	44,44	56	12,99	129	14,29			
	<i>Sciara sp.</i>	-	-	-	-	-	-	-	-	-	-	-	1	1,23	-	-	-	-	-		
Cecidomyiidae	<i>Cecidomyiidae sp. ind.</i>	-	-	-	2	12,50	-	-	-	-	2	15,4	4	4,94	165	38,28	-	-	-		
	<i>Contarinia sp.</i>	3	0,65	-	1	6,25	-	-	-	-	-	-	-	9	2,09	-	-	-	-		
Bibionidae	<i>Bibio sp.</i>	1	0,22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Mycetophilidae	<i>Rhymosia fenestralis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	0,44			
	Sous ordre des Brachycera																				
Stratiomyidae	<i>Chorisops sp.</i>	-	-	2	1,16	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	<i>Cephalochrysa nigricornis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Asilidae	<i>Machimus sp.</i>	-	-	-	-	-	-	-	-	-	1	7,69	-	-	1	0,23	-	-	-		
Therevidae	<i>Thenvidae sp. ind.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	5	1,16	164	18,16			
	<i>Platypalpus trivialis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	5	1,16	164	18,16			
Empididae	<i>Hilara maura</i>	75	16,13	-	1	6,25	2	40,00	-	3	23,1	11	13,58	4	0,93	28	3,10	-	-		
	<i>Chersodromia sp.</i>	47	10,11	7	4,07	-	-	1	20,00	-	1	7,69	-	21	4,87	5	0,55	-	-		
	<i>Drapetis aterrima</i>	-	-	-	-	-	-	-	-	-	-	2	2,47	-	-	-	-	-	-		
	<i>Conicera dauci</i>	-	-	2	1,16	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Phoridae	<i>Hypocera sp.</i>	2	0,43	1	0,58	-	-	-	-	-	-	-	-	5	1,16	7	0,78	-	-		
	<i>Gymnophora sp.</i>	122	26,24	41	23,84	-	-	-	1	12,5	1	7,69	2	2,47	102	23,67	23	2,55			
	<i>Leucanocerus sp.</i>	5	1,08	3	1,74	5	31,25	-	-	-	7,69	-	-	-	2	0,22	-	-	-		
	<i>Chonocephalus sp.</i>	-	-	1	0,58	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	<i>Helophilus frutetorum</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0,11	-	-		
Syrphidae	<i>Syrphus bifasciatus</i>	4	0,86	-	1	6,25	-	-	-	-	-	-	-	1	0,23	-	-	-	-		
	<i>Eristalis aeneus</i>	3	0,65	1	0,58	-	-	-	-	-	-	-	-	-	-	9	1,00	-	-		
	<i>Episyrphus balteatus</i>	-	-	1	0,58	-	-	-	-	-	-	1	1,23	12	2,78	2	0,22	-	-		
Pipunculidae	<i>Pipunculus sylvaticus</i>	-	-	-	-	-	-	-	-	-	-	1	1,23	-	-	-	-	-	-		
Opomyzidae	<i>Opomyza sp.</i>	-	-	2	1,16	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Drosophilidae	<i>Drosophila melanogaster</i>	2	0,43	3	1,74	-	-	-	-	-	-	-	-	2	0,46	-	-	-	-		
	<i>Drosophila sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	3	0,70	-	-	-	-		
	<i>Phytomyza sp.</i>	1	0,22	1	0,58	-	-	-	2	25	-	1	1,23	3	0,70	34	3,77	-	-		
	<i>Conicera dauci</i>	-	-	2	1,16	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Phoridae	<i>Hypocera sp.</i>	2	0,43	1	0,58	-	-	-	-	-	-	-	-	5	1,16	7	0,78	-	-		
	<i>Gymnophora sp.</i>	122	26,24	41	23,84	-	-	-	1	12,5	1	7,69	2	2,47	102	23,67	23	2,55			
	<i>Leucanocerus sp.</i>	5	1,08	3	1,74	5	31,25	-	-	-	7,69	-	-	-	-	2	0,22	-	-		
	<i>Chonocephalus sp.</i>	-	-	1	0,58	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	<i>Helophilus frutetorum</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0,11	-	-		
Syrphidae	<i>Syrphus bifasciatus</i>	4	0,86	-	1	6,25	-	-	-	-	-	-	-	1	0,23	-	-	-	-		
	<i>Eristalis aeneus</i>	3	0,65	1	0,58	-	-	-	-	-	-	-	-	-	-	9	1,00	-	-		
	<i>Episyrphus balteatus</i>	-	-	1	0,58	-	-	-	-	-	-	1	1,23	12	2,78	2	0,22	-	-		
Pipunculidae	<i>Pipunculus sylvaticus</i>	-	-	-	-	-	-	-	-	-	-	1	1,23	-	-	-	-	-	-		
Opomyzidae	<i>Opomyza sp.</i>	-	-	2	1,16	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Drosophilidae	<i>Drosophila melanogaster</i>	2	0,43	3	1,74	-	-	-	-	-	-	-	-	2	0,46	-	-	-	-		
	<i>Drosophila sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	3	0,70	-	-	-	-		
	<i>Phytomyza sp.</i>	1	0,22	1	0,58	-	-	-	2	25	-	1	1,23	3	0,70	34	3,77	-	-		
Agomyzidae	<i>Agomyzidae sp.1 ind.</i>	-	-	-	2	12,50	-	-	1	12,5	-	-	-	2	0,46	3	0,33	-	-		
Agomyzidae	<i>Agomyzidae sp.2 ind.</i>	-	-	-	-	-	-	-	-	-	2	15,4	1	1,23	-	-	-	-	-		
Tephritidae	<i>Acanthiophilus sp.</i>	-	-	-	1	6,25	-	-	-	-	-	-	-	-	-	-	-	-	-		
Sepsidae	<i>Sepsis punctum</i>	-	-	1	0,58	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Anthomyiidae	<i>Hydrophoria sp.1</i>	7	1,51	4	2,33	-	-	-	-	-	-	-	-	1	0,23	-	-	-	-		
	<i>Hydrophoria sp.2</i>	-	-	-	-	-	-	-	-	-	-	1	1,23	-	-	-	-	-	-		
	<i>Musca domestica</i>	-	-	-	-	-	-	-	-	-	-	-	-	2	0,46	-	-	-	-		
	<i>Hydrotaea irritans</i>	2	0,43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	<i>Fannia canicularis</i>	-	-	1	0,58	-	-	-	-	-	-	-	-	-	-	1	0,11	-	-		
Muscidae	<i>Stomoxys calcitrans</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0,11	-	-		
	<i>Calliphora erythrocephala</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	0,78	-	-		
Calliphoridae	<i>Calliphora sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	2	0,46	-	-	-	-		
	<i>Lucilia sp.</i>	1	0,22	-	-	-	-	-	-	-	-	2	2,47	-	-	-	-	-	-		
	<i>Sarcophaga melanura</i>	-	-	1	0,58	1	6,25	-	-	-	-	-	-	-	2	0,46	-	-	-		
Sarcophagidae	<i>Sarcophaga carnaria</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	0,23	5	0,55	-	-		
Anthophoridae	<i>Anthophoridae sp. ind.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0,33	-	-		
Tachinidae	<i>Gymnocheila viridis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0,22	-	-		
	<i>Tachina fera</i>	2	0,43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Total: 26	Total: 55	465	1	172	100	16	100	5	100	8	100	13	100	81	100	431	100	903	100		

ni. the number of individuals; A. R. %: relatif abundance ; ind. unspecified

Table 2: Relative Abundance of Dipterans Species Captured in Coloured Traps in Station of Maquis

		X		2009								2010														
Familles	Espèces	ni	AR %	XI	AR %	XII	ni	AR %	I	ni	AR %	II	ni	AR %	III	ni	AR %	IV	ni	AR %	V	ni	AR %	VI	ni	AR %
	Sous ordre Nematocera																									
Psychodidae	<i>Psychoda alternata</i>	2	0,78	1	0,57	-	-	-	-	-	-	-	-	-	1	3,45	-	-	5	1,37						
	<i>Phlebotomus perniciosus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1,04	7	1,91						
	<i>Culex impudicus</i>	1	0,39	-	-	-	-	-	-	-	-	-	1	3,23	-	-	2	1,04	1	0,27						
Culicidae	<i>Culiseta longiareolata</i>	-	-	1	0,57	1	12,5	-	-	-	-	-	-	-	-	-	1	0,52	-	-						
Ceratopogonidae	<i>Culicoides imicola</i>	3	1,16	-	-	-	-	-	-	-	-	-	2	6,45	-	-	2	1,04	-	-						
Chironomidae	<i>Chironomus plumosus</i>	9	3,49	2	1,15	-	-	1	5,26	-	-	-	-	1	3,45	7	3,63	-	-							
	<i>Chironomus tendens</i>	2	0,78	-	-	-	-	1	5,26	1	6,67	1	3,23	2	6,90	-	-	-	-							
Tipulidae	<i>Pachyrhynchos sp.</i>	-	-	1	0,57	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0,27						
Sciaridae	<i>Sciarra sp.</i>	1	0,39	-	-	-	-	1	5,26	-	-	1	3,23	5	17,24	1	0,52	2	0,55							
Sous ordre des Brachycera																										
Stratiomyidae	<i>Chorisops sp.</i>	1	0,39	1	0,57	-	-	1	5,26	1	6,67	-	-	-	-	-	-	1	0,27							
	<i>Cephalochrysa nigricornis</i>	-	-	1	0,57	-	-	-	-	-	-	-	-	1	3,45	1	0,52	4	1,09							
Empididae	<i>Tachydromia sp.</i>	1	0,39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
Dolichopodidae	<i>Dolichopus claviger</i>	-	-	-	-	-	-	-	-	-	-	1	3,23	3	10,34	-	-	1	0,27							
Phoridae	<i>Gymnophora sp.</i>	-	-	1	0,57	-	-	1	5,26	1	6,67	-	-	1	3,45	3	1,55	-	-							
	<i>Leucanocerus sp.</i>	8	3,10	19	10,92	2	25	-	-	-	-	3	9,68	-	-	-	-	-	-							
	<i>Phora sp.</i>	3	1,16	1	0,57	-	-	-	-	-	-	1	3,23	-	-	-	-	1	0,27							
Sphaeroceridae	<i>Leptocera atoma</i>	4	1,55	-	-	-	-	-	-	-	-	1	3,23	-	-	39	20,21	37	10,11							
	<i>Leptocera septentrionalis</i>	143	55,43	27	15,52	3	37,5	1	5,26	3	20,00	-	-	3	10,34	67	34,72	216	59,02							
	<i>Sphaerocera curvipes</i>	-	-	-	-	-	-	-	-	-	-	1	3,23	-	-	-	-	-	-							
Scatophagidae	<i>Scatophaga stollia</i>	2	0,78	4	2,30	1	12,5	2	10,53	-	-	2	6,45	-	-	-	-	3	0,82							
Syrphidae	<i>Eristalis tenax</i>	1	0,39	2	1,15	-	-	1	5,26	2	13,33	-	-	2	6,90	-	-	8	2,19							
	<i>Syrphus auricollis</i>	-	-	-	-	-	-	-	-	-	-	2	6,45	-	-	2	1,04	-	-							
	<i>Epistrophe sp.</i>	-	-	1	0,57	-	-	-	-	-	-	-	-	-	-	-	-	1	0,27							
Pipunculidae	<i>Pipunculus sylvaticus</i>	-	-	-	-	-	-	-	-	-	-	-	1	3,45	-	-	5	1,37								
Opomyzidae	<i>Opomyza sp.</i>	-	-	-	-	-	-	-	-	-	-	1	3,23	-	-	1	0,52	-	-							
Agromyzidae	<i>Agromyzidae sp. 1 ind.</i>	3	1,16	-	-	-	-	-	-	1	6,67	-	-	-	-	1	0,52	-	-							
Chloropidae	<i>Elachiptera coronata</i>	49	18,99	105	60,34	-	-	6	31,58	-	-	9	29,03	2	6,90	-	-	7	1,91							
Sepsidae	<i>Sepsis punctum</i>	2	0,78	1	0,57	-	-	-	-	-	-	-	2	6,90	-	-	4	1,09								
	<i>Sepsis cynipsea</i>	-	-	-	-	1	12,5	-	-	-	-	3	9,68	-	-	-	-	-	-							
	<i>Sepsis sp.</i>	9	3,49	2	1,15	-	-	-	-	-	-	-	-	-	-	51	26,42	47	12,84							
Calliphoridae	<i>Calliphora erythrocephala</i>	2	0,78	1	0,57	-	-	-	-	-	-	4	26,67	-	-	4	13,79	-	-							
	<i>Lucilia sp.</i>	3	1,16	2	1,15	-	-	2	10,53	1	6,67	-	-	-	-	2	1,04	8	2,19							
Sarcophagidae	<i>Sarcophaga muscaria</i>	6	2,33	1	0,57	-	-	-	-	1	6,67	-	-	1	3,45	7	3,63	2	0,55							
	<i>Sarcophaga sp.</i>	3	1,16	-	-	-	-	2	10,53	-	-	2	6,45	-	-	4	2,07	5	1,37							
Total: 20	Total: 34	258	100	174	100	8	100	19	100	15	100	31	100	29	100	193	100	366	100							

ni. the number of individuals; A.R. %: relatif abundance ; ind. unspecified

Table 3: Relative Abundance of Dipterans Species Captured in Coloured Traps in Station of Ponds

Familles	Especes	2009		2010		2011		2012		2013		2014		2015		2016		2017	
		X ni	AR%	XI ni	AR%	XII ni	AR%	I ni	AR%	II ni	AR%	III ni	AR%	IV ni	AR%	V ni	AR%	VI ni	AR%
Sous-ordre des Nematocera																			
Psychodidae	<i>Psychoda alternata</i>	13	9,42	24	23,76	1	12,5	-	-	-	-	-	-	-	-	-	6	11,32	
Culicidae	<i>Anopheles labranchiae</i>	1	0,72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	<i>Culex impudicus</i>	2	1,45	1	0,99	-	-	-	-	-	1	14,29	-	-	3	10,71	-	-	
	<i>Culex hortensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1,89	
Ceratopogonidae	<i>Culicoides copiosus</i>	-	-	3	2,97	2	25	-	-	-	-	-	2	15,4	-	-	6	11,32	
	<i>Culicoides imicola</i>	28	20,29	7	6,93	-	-	-	-	-	1	14,29	2	15,4	2	7,14	4	7,55	
	<i>Culicoides albicans</i>	-	-	1	0,99	-	-	-	-	-	-	-	-	-	-	-	-	-	
Chironomidae	<i>Culicoides absoluteus</i>	2	1,45	1	0,99	-	-	-	-	-	-	-	-	-	-	-	-	-	
	<i>Chironomus plumosus</i>	3	2,17	-	-	1	12,5	-	-	-	-	-	-	-	4	14,29	5	9,43	
	<i>Chironomus piger</i>	2	1,45	2	1,98	-	-	-	-	1	6,67	-	-	3	23,1	-	-	-	
	<i>Chironomus riparius</i>	-	-	-	-	2	25	1	16,67	-	-	-	-	-	-	-	-	-	
	<i>Chironomus aprilinus</i>	-	-	-	-	-	-	-	-	-	1	14,29	-	-	-	-	-	-	
	<i>Chryptochironomus supplicans</i>	1	0,72	-	-	-	-	-	-	1	6,67	2	28,57	1	7,69	-	-	2	3,77
Dixidae	<i>Dixa maculata</i>	-	-	1	0,99	-	-	-	-	-	-	-	-	-	-	-	-	-	
Limoniidae	<i>Dicranota</i> sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	1	3,57	-	-	
Mycetophilidae	<i>Rhymosia fenestralis</i>	1	0,72	-	-	-	-	-	-	7	46,67	-	-	1	7,69	-	-	-	
Sous ordre des Brachycera																			
Dolichopodidae	<i>Dolichopus</i> sp.	2	1,45	-	-	-	-	1	16,67	3	20,00	-	-	-	-	-	-	-	
	<i>Hercostomus</i> sp.	-	-	3	2,97	-	-	-	-	-	-	-	1	7,69	5	17,9	2	3,77	
Syrphidae	<i>Hydrophorus</i> sp.	1	0,72	1	0,99	-	-	-	-	-	-	-	-	-	-	-	-	-	
	<i>Eristalis tenax</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1	3,57	-	-	
Chloropidae	<i>Sericomyia silensis</i>	1	0,72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Tephritidae	<i>Elachiptera coronata</i>	78	56,52	56	55,45	-	-	-	-	2	13,33	2	28,57	2	15,4	6	21,4	11	20,75
Sepsidae	<i>Tephritis</i> sp.	-	-	1	0,99	1	12,5	-	-	-	-	-	-	-	-	-	3	5,66	
Fanniidae	<i>Sepsis punctum</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	2	7,14	5	9,43	
Muscidae	<i>Phaonia scutellaris</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1	3,57	-	-	
Calliphoridae	<i>Musca domestica</i>	3	2,17	-	-	-	-	4	66,67	1	6,67	-	-	-	-	-	4	7,55	
Tachinidae	<i>Calliphora vicina</i>	-	-	-	-	1	12,5	-	-	-	-	-	-	-	-	-	-	-	
	<i>Calliphora</i> sp.	-	-	-	-	-	-	-	-	-	-	-	1	7,69	-	-	-	-	
	<i>Gymnochaeta viridis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	3	10,7	4	7,55	
Total: 16	Total: 29	138	100	101	100	8	100	6	100	15	100	7	100	13	100	28	100	53	100

ni. the number of individuals; A.R. %: relatif abundance ; ind. unspecified

Table 4: Diversity Index Values of Shannon-Weaver and Equitability of Dipterans Species Captured in Coloured Traps around of Marsh of Reghaia

		2009				2010			
Mois	X	XI	XII	I	II	III	IV	V	VI
N	465	172	16	5	8	13	81	431	903
S	20	21	10	3	4	8	17	25	22
H' (bits)	2,44	2,33	3,02	1,52	1,75	2,46	2,78	2,88	2,73
H'max (bits)	4,32	4,39	3,32	1,58	2,00	3,00	4,09	4,64	4,46
E	0,56	0,53	0,91	0,96	0,88	0,82	0,68	0,62	0,61

Table 5: Diversity Index Values of Shannon-Weaver and Equitability of Dipterans Species Captured in Coloured Traps in Maquis

		2009				2010			
Mois	X	XI	XII	I	II	III	IV	V	VI
N	258	174	8	19	15	31	29	193	367
S	22	19	5	11	9	15	14	17	21
H' (bits)	2,44	2,01	2,15	2,89	2,92	3,47	3,58	2,6	2,31
H'max. (bits)	4,46	4,25	2,32	3,46	3,17	3,91	3,81	4,09	4,39
E	0,55	0,52	0,93	0,84	0,92	0,89	0,94	0,64	0,53

Table 6: Diversity Index Values of Shannon-Weaver and Equitability of Dipterans Species Captured in Coloured Traps Surrounding Ponds

		2009				2010			
Mois	X	XI	XII	I	II	III	IV	V	VI
N	138	101	8	6	15	7	13	28	53
S	14	12	6	3	6	5	8	10	12
H' (bits)	2,1	2,01	2,5	1,27	2,14	2,24	2,87	3,07	3,37
H'max.(bits)	3,81	3,58	2,58	1,58	2,58	2,32	3,00	3,32	3,58
E	0,55	0,56	0,97	0,80	0,83	0,96	0,96	0,92	0,94

Annex 1: Applied Code of Trapped Species by coloured traps in Factorial Analysis of Correspondences in marsh of Reghaia

Table 7

001- <i>Pericoma fusca</i>	028- <i>Hilara maura</i>	055- <i>Sepsis cynipsea</i>	082- <i>Agomyzidae sp.1 ind.</i>
002- <i>Psychoda alternata</i>	029- <i>Chersodromia sp.</i>	056- <i>Sepsis sp.</i>	083- <i>Agomyzidae sp.2 ind.</i>
003- <i>Phlebotomus perniciosus</i>	030- <i>Drapetis aterrima</i>	057- <i>Phaonia scutellaris</i>	084- <i>Tephritis sp.</i>
004- <i>Anopheles labranchiae</i>	031- <i>Tachydromia sp.</i>	058- <i>Anthophoridae sp ind.</i>	085- <i>Acanthophilus sp.</i>
005- <i>Culex pipiens</i>	032- <i>Chorisops sp.</i>	059- <i>Elachiptera coronata</i>	086- <i>Bibio sp.</i>
006- <i>Culex impudicus</i>	033- <i>Cephalochrysa nigricornis</i>	060- <i>Sarcophaga sp.</i>	087- <i>Drosophila melanogaster</i>
007- <i>Culex hortensis</i>	034- <i>Rhymosia fenestralis</i>	061- <i>Sarcophaga melanura</i>	088- <i>Drosophila sp.</i>
008- <i>Culiseta longiareolata</i>	035- <i>Conicera dauci</i>	062- <i>Sarcophaga carnaria</i>	089- <i>Dixa maculata</i>
009- <i>Chironomus plumosus</i>	036- <i>Hypocera sp.</i>	063- <i>Sarcophaga muscaria</i>	090- <i>Dicranota sp.</i>
010- <i>Chironomus tentans</i>	037- <i>Gymnophora sp.</i>	064- <i>Opomyza sp.</i>	091- <i>Dolichopus claviger</i>
011- <i>Chironomus nubeculosus</i>	038- <i>Leucanocerus sp.</i>	065- <i>Calliphora erythrocephala</i>	092- <i>Scatophaga suillia</i>
012- <i>Chironomus piger</i>	039- <i>Chonocephalus sp.</i>	066- <i>Calliphora sp.</i>	
013- <i>Chironomus riparius</i>	040- <i>Phora sp.</i>	067- <i>Lucilia sp.</i>	
014- <i>Chironomus aprilinus</i>	041- <i>Hydrophoria sp.1</i>	068- <i>Caliphora vicina</i>	
015- <i>Chryptochironomus supplicans</i>	042- <i>Hydrophoria sp.2</i>	069- <i>Musca domestica</i>	
016- <i>Culicoides copiosus</i>	043- <i>Leptocera atoma</i>	070- <i>Hydrotaea irritans</i>	
017- <i>Culicoides imicola</i>	044- <i>Leptocera septentrionalis</i>	071- <i>Fannia canicularis</i>	
018- <i>Culicoides albicans</i>	045- <i>Sphaerocera curvipes</i>	072- <i>Stomoxys calcitrans</i>	
019- <i>Culicoides absoletus</i>	046- <i>Helophilus frutetorum</i>	073- <i>Therividae sp. ind.</i>	
020- <i>Cedomyiidae sp.1 ind.</i>	047- <i>Syrphus bifasciatus</i>	074- <i>Gymnochaeta viridis</i>	
021- <i>Contarinia sp.</i>	048- <i>Episyrphus balteatus</i>	075- <i>Tachina fera</i>	
022- <i>Tipula sp.</i>	049- <i>Eristalis aeneus</i>	076- <i>Dolichopus sp.</i>	
023- <i>Pachyrhyna sp.</i>	050- <i>Eristalis tenax</i>	077- <i>Hercostomus sp.</i>	
024- <i>Sciara bicolor</i>	051- <i>Syrphus auricollis</i>	078- <i>Hydrophorus sp.</i>	
025- <i>Sciara sp.</i>	052- <i>Epistrophe sp.</i>	079- <i>Rhymosia fenestralis</i>	
026- <i>Machimus sp.</i>	053- <i>Sericomyia silensis</i>	080- <i>Pipunculus sylvaticus</i>	
027- <i>Platypalpus trivialis</i>	054- <i>Sepsis punctum</i>	081- <i>Phytomyza sp.</i>	

ind. unspecified

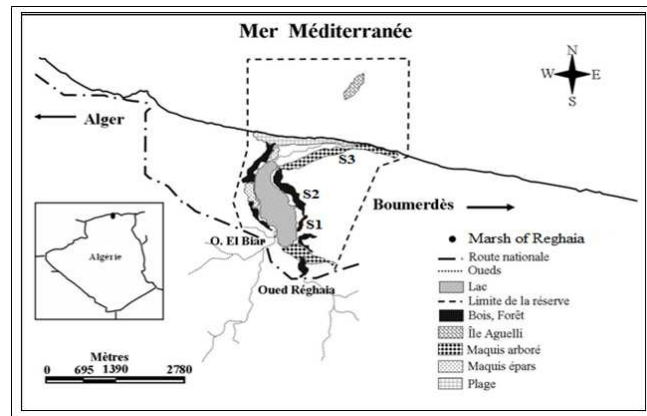


Figure 1: Geographic Location of the Marsh of Reghaia (Algeria) (Mutin, 1977, Modified)
S1: Station Surrounding Marsh of Reghaia; S2: Station of Maquis; S3: Station of Ponds

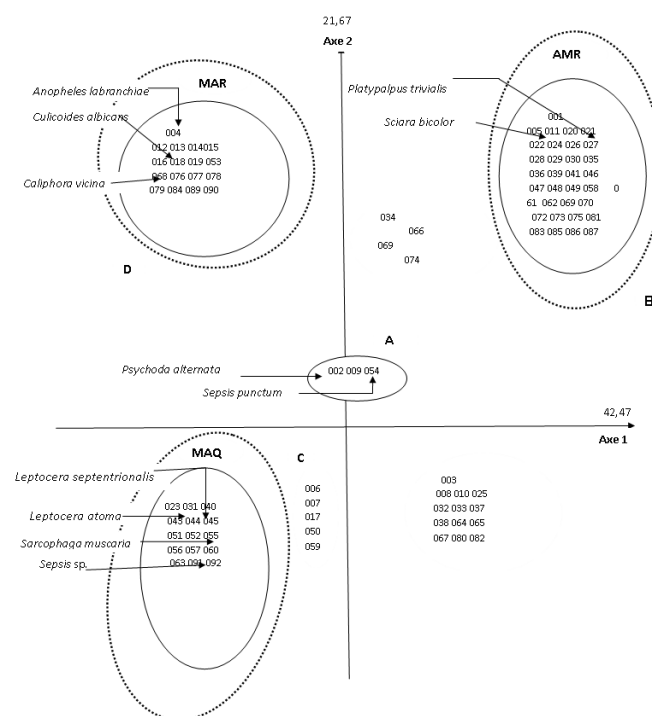


Figure 2: Factorial Map of Trapped Species by Coloured Traps in the Three Studies Stations

